REMARKS

Reexamination and reconsideration of this application as amended is requested. Claims 1, 12, and 18 have been amended. After this amendment, Claims 1-29 remain pending in this application. Applicant submits that the present response places the application in condition for allowance. Entry of the present response is therefore respectfully requested.

Telephonic Interview

As an initial matter, the Applicant would like to thank Examiner Tucker for the telephonic interview held on Tuesday, December 13, 2005. Patent attorney Thomas Grzesik and Examiner Tucker participated in the telephone call. Discussed was a general overview of the present invention and how it differs from the prior art of record. The Applicant agreed to further clarify the claim language to positively recite that the three or more images are captured simultaneously. No further agreement was reached on the telephonic interview.

Claim Rejections - 35 USC § 112

The Exmainer rejected claims 1, 12, and 18 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. In particular the Examiner states that "the claim language 'determining 3-D depth of the plurality of pixels in the base image by simultaneously matching correspondence to a plurality of pixels in three or more images' contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art tha the inventor(s), at the time the application was filed, had possesstion of the claimed invention". The Examiner goes on to state that it is unclear how a matching correspondence can be performed simultaneously between a base image and multiple other image and further it is unclear how the 3-D depth information is determined

by matching correspondence.

The Applicant has amended claims 1, 12, and 18 to now more clearly recite:

"determining 3-D depth of the plurality of pixels in the base image by matching correspondence to a plurality of pixels in three or more images, each image representing one of the at least three views of the scene, wherein the three or more images are captured simultaneously, and wherein each of the at least three views of the scene are situated in a non-linear arrangement and are further oriented in a plurality of non-parallel planes relative to each other"

Support for this amended is found in the Specification as originally filed, see for example, page 13, lines 8-12; page 14, line 14; and page 22, lines 1-9. No new matter has been added.

Accordingly, the Applicant believes that claims 1, 12, and 18 now recite in allowable form and respectfully request that the rejection of these claims under 35 U.S.C. § 112, first paragraph be withdrawn.

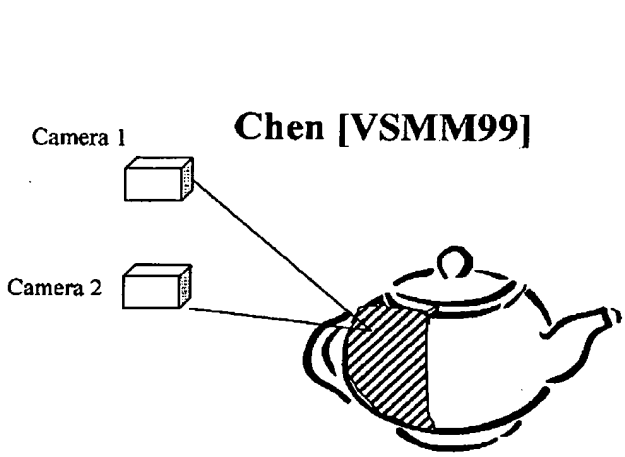
Claim Rejections - 35 USC § 102

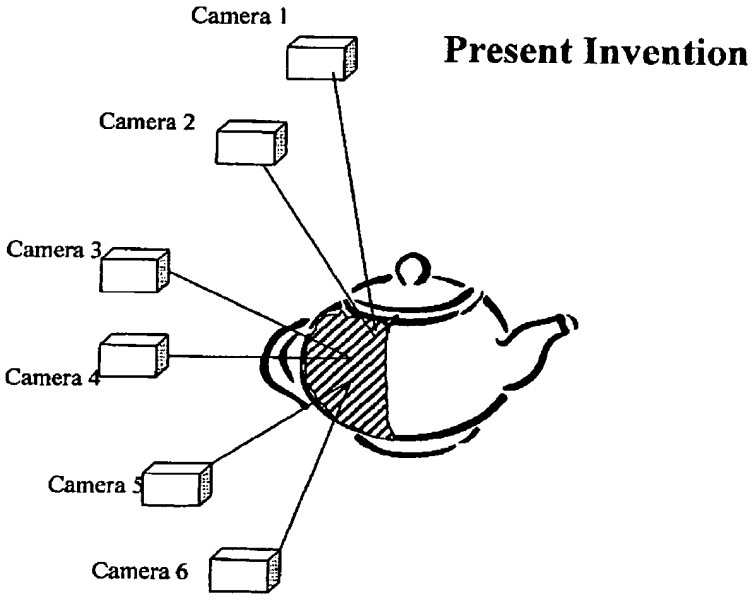
The Examiner rejected Claims 1, 4-9, 12-18, and 21-26 under 35 U.S.C. 102(b) as being anticipated by Chen and Medioni, "A Volumetric Stereo Matching Method: Application to Image-Based Modeling"' IEEE 19999.

Applicant has amended independent Claims 1, 12, and 18 to more clearly and distinctly recite the present invention. Applicant has amended Claims 1, 12 and 18 to more clearly recite "determining 3-D depth of the plurality of pixels in the base image by matching correspondence to a plurality of pixels in three or more images, each image representing one of the at least three views of the scene, wherein the three or more images are captured simultaneously, and wherein each of the at least three views of the scene are situated in a non-linear arrangement and are

further oriented in a plurality of non-parallel planes relative to each other". Support for these amendments may be found in the specification as originally filed, see for example page 13, lines 8-12; page 14, line 14; and page 22, lines 1-9. No new matter was added.

The Examiner directs Applicant to example 4 on page 34 in Chen [VSMM99] where 6 views of a tea pot are used. Chen [VSMM99] teaches using two cameras to take multiple pictures of a tea pot spinning on a turntable. In other words, only two images at a time can be captured. Furthermore, Chen [VSMM99] teaches that only two images are matched at a time. See Chen [VSMM99] generally and at section 3.2 "Disparity surface extraction". Chen [VSMM99] may take multiple pictures in sets of two at a time (by using only two cameras), but Chen [VSMM99] does not simultaneously capture three or more images. The following figures are included to help illustrate the differences between the present invention and Chen [VSMM99].





The Shaded area is the "slice" to be reconstructed at the current scan

In Chen [VSMM99], there is a pair of cameras. Therefore, the correspondence consists of two (2) images. Assuming that each scan represents 1/6 of the teapot surface, Chen [VSMM99] needs a total of six (6) pairs of views, i.e. twelve (12) images. The present invention, on the other hand, can use a plurality of cameras and is not limited to only using two (2) cameras. In the above example, a total of six (6) cameras are used. Therefore, the correspondence consists of six (6) images. Assuming again that each scan represents 1/6 of the teapot surface; the present invention yields a total of eighteen (18) views for a total of thirty-six (36) images. The images from each camera, six (6) in the above example, are taken at the same time yielding six (6) images that were taken simultaneously. Using multiple cameras (more than two) arranged in multiple baselines is advantageous over binocular stereo methods. For example, matching ambiguity is decreased and reconstruction precision is increased. Therefore, the present invention distinguishes over Chen [VSMM99] for at least these reasons.

Additionally, the Examiner states that Chen [VSMM99] teaches the "matching correspondence" of the present invention. However, Chen only teaches using two cameras and processing these images two at a time. Therefore, Chen [VSMM99] is only matching correspondence between pixels of two images at a time and then obtains a result. In Section 3.2.1 of Chen [VSMM99] entitled "Algorithm description", Chen [VSMM99] states "the output from our matching algorithm is a disparity map which corresponds to the voxels that comprise the disparity surface. This is where it differentiates itself from volume rendering, or other matching methods that model the disparity surface as a continuous function". Chen [VSMM99] is comparing disparity surfaces, in other words, Chen [VSMM99] compares the disparity between two surfaces at a time. The (u,v,d) space is working with only two images at a time. The present invention, on the other hand, matches correspondence between all of the images that were taken simultaneously, for example, three or more images taken simultaneously and obtains a result. See for example, page 14, line 14 of the Specification as originally filed. Furthermore, the presently claimed invention recites "wherein each of the at least three views of the scene are situated in a non-linear arrangement and are further oriented in a plurality of non-parallel planes relative to each other". Nowhere does Chen teach that the at least three views of the scene that

are captured simultaneously are arranged in a non-linear fashion and oriented in a plurality of non-parallel planes. See, for example, the Specification as originally filed at page 7, lines 6-13.

The presently claimed invention and Chen [VSMM99] are working in two different spaces. The present invention, as recited for claims 1, 12, 18, is working in a multiple image volume space and Chen [VSMM99] is working in a two-image disparity space. Chen [VSMM99] specifically states that it is not performing volume rendering. See previous paragraph. Disparity space cannot be used when working when matching three or more images simultaneously. Where the Examiner points to in section 3.2 of Chen [VSMM99] is directed towards two images only. Accordingly, the present invention distinguishes over Chen [VSMM99] for at least these reasons as well.

The Examiner cites 35 U.S.C. § 102(b) and a proper rejection requires that a single reference teach (i.e., identically describe) each and every element of the rejected claims as being anticipated by Chen [VSMM99].[1] Because the elements in independent claims 1, 12, and 18 of "matching correspondence to a plurality of pixels in three or more images...wherein the three or more images are captured simultaneously" and "tracing pixels in a virtual piecewise continuous depth surface by spatial propagation starting from the detected pixels in the base image by using the matching and corresponding plurality of pixels in the three or more images to create the virtual piecewise continuous depth surface viewed from the base image, each successfully traced pixel being associated with a depth in the scene viewed from the base image" are not taught, anticipated, or even suggested, by Chen [VSMM99], the Chen [VSMM99] reference does not teach, anticipate, or suggest, each and every element of Claims 1, 12, and 18.

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[1] See MPEP §2131 (Emphasis Added) "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the ... claim."

For the foregoing reasons, Claims 1, 12, and 18 distinguish over Chen [VSMM9]. Claims 4-9, 13-17, and 21-26 depend from claims 1, 12, and 18, respectively. Since dependent claims contain all the limitations of the independent claims, claims 4-9, 13-17, and 21-26 distinguish over Chen [VSMM9], as well. Accordingly, Applicant believes that the rejection under 35 U.S.C. § 102(b) has been overcome and respectfully requests that this rejection be withdrawn.

Claim Rejections - 35 USC § 103

The Examiner rejected Claims 27-28 under 35 U.S.C. 103(a) as being unpatentable over Chen and Medioni, "A Volumetric Stereo Matching Method: Application to Image-Based Modeling"' IEEE 19999.

Claims 27-28 depend from amended Claim 18. The above arguments and remarks regarding Claim 18 are likewise applicable here in support of the allowability of Claims 27-28. These applicable arguments have already been presented above and will not be repeated here.

Accordingly, in view of the amendments and remarks above, since Chen [VSMM99] does not teach, anticipate, or suggest, the presently claimed "...determining 3-D depth of the plurality of pixels in the base image by matching correspondence to a plurality of pixels in three or more images, each image representing one of the at least three views of the scene, wherein the three or more images are captured simultaneously, and wherein each of the at least three views of the scene are situated in a non-linear arrangement and are further oriented in a plurality of non-parallel planes relative to each other; and tracing pixels in a virtual piecewise continuous depth surface by spatial propagation starting from the detected pixels in the base image by using the matching and corresponding plurality of pixels in the three or more images to create the virtual piecewise continuous depth surface viewed from the base image, each successfully traced pixel being associated with a depth in the scene viewed from the base image" as recited for amended Claim 18 from which Claims 26-27 depend from, Applicant believes that the rejection of Claims

27-28 under 35 U.S.C. 103(a) has been overcome. The Examiner should withdraw the rejection of these claims.

The Examiner rejected Claims 2-3 and 19-20 under 35 U.S.C. 103(a) as being unpatentable over Chen and Medioni, "A Volumetric Stereo Matching Method: Application to Image-Based Modeling"' IEEE 19999 in view of Zhang, Deriche, Faugeras, and Luong, "A Robust Technique for Matching Two Uncalibrated Images Through the Recovery of Unknown Epipolar Geometry", INRIA 1994).

Claims 2-3 and 19-20 depend from amended Claims 1 and 18, respectively. The above arguments and remarks regarding Claims 1 and 18 are likewise applicable here in support of the allowability of Claims 2-3 and 19-20. These applicable arguments have already been presented above and will not be repeated here.

The Applicant repeats here the arguments made in the previous Response With Amendment dated October 12, 2005 regarding Zhang. Zhang teaches a robust technique for matching two uncalibrated images through the recovery of the unknown epipolar geometry. The Examiner has directed Applicant to Section 6.3 on pages 16-19 of Zhang, wherein Zhang teaches a stereo matching method. Additionally, Zhang teaches that outliers will severely affect the precision of the fundamental Matrix taught by Zhang. Therefore, possible outliers should be taken into account in the initial correspondences. However, Zhang does not teach or suggest "determining 3-D depth of the plurality of pixels in the base image by simultaneously matching correspondence to a plurality of pixels in three or more images...wherein the three or more images are captured simultaneously" nor does the reference teach or suggest that each image represents one of the at least three views of the scene that are situated in a non-linear arrangement and are further oriented in a plurality of non-parallel planes relative to each other. See for example FIG. 1. Further, Zhang does not teach or suggest "tracing pixels in a virtual piecewise continuous depth surface by spatial propagation starting from the detected pixels in the base image by using the matching and corresponding plurality of pixels in the three or more images to create the virtual piecewise continuous depth surface viewed from the base image,

each successfully traced pixel being associated with a depth in the scene viewed from the base image" as presently claimed in Claims 1 and 18. Therefore, Zhang does not teach or suggest the presently claimed invention as recited for amended independent Claims 1 and 18 from which dependent Claims 2-3 and 19-20 depend from, respectively.

Accordingly, in view of the amendments and remarks above, since Chen [VSMM99] taken alone and/or in view of Zhang does not teach, anticipate, or suggest, the presently claimed "...determining 3-D depth of the plurality of pixels in the base image by simultaneously matching correspondence to a plurality of pixels in three or more images, each image representing one of the at least three views of the scene, wherein the three or more images are captured simultaneously, and wherein each of the at least three views of the scene are situated in a non-linear arrangement and are further oriented in a plurality of non-parallel planes relative to each other; and tracing pixels in a virtual piecewise continuous depth surface by spatial propagation starting from the detected pixels in the base image by using the matching and corresponding plurality of pixels in the three or more images to create the virtual piecewise continuous depth surface viewed from the base image, each successfully traced pixel being associated with a depth in the scene viewed from the base image" as recited for amended Claims 1 and 18 from which Claims 2-3 and 19-20 respectively depend from, Applicant believes that the rejection of Claims 2-3 and 19-20 under 35 U.S.C. 103(a) has been overcome. The Examiner should withdraw the rejection of these claims.

The Examiner rejected Claims 10-11 under 35 U.S.C. 103(a) as being unpatentable over Chen and Medioni, "A Volumetric Stereo Matching Method: Application to Image-Based Modeling"' IEEE 19999 in view of Okutomi and Kanade, "A Multiple-Baseline Stereo", IEEE 1993 in further view of Lewis, "Fast normalized Cross-Correlation", 1995.

Claims 10-11 depend from amended Claim 1. The above arguments and remarks regarding Claim 1 are likewise applicable here in support of the allowability of Claims 10-11. These applicable arguments have already been presented above and will not be repeated here.

As has already been previously discussed in Applicant's previous responses (see OA dated October 10, 2004 and OA dated October 12, 2005), Okutomi teaches a stereo matching method that uses multiple stereo pairs with various baselines to obtain precise distance estimates without suffering from ambiguity. The Examiner specifically pointed to Okutomi, the Abstract - sentence 1, and also page 353-355, and page 362, wherein Okutomi teaches that the summation of the sum of squared differences (SSD) from multiple stereo pairs can be used to indicate the "correctness" of a set of matching points. However, Okutomi clearly does not teach or suggest the presently claimed invention as recited for amended independent Claim 1, and for dependent Claims 10-11.

As has already been previously discussed in the previous response dated October 12, 2005, Lewis teaches how un-normalized cross correlation can be efficiently normalized using precomputing integrals of the image and image^2 over the search window. However, it should be clear that Lewis does not teach or suggest the presently claimed invention as recited for amended independent Claim 1, and for dependent Claims 10-11.

Accordingly, in view of the amendments and remarks above, since the teachings of Chen [VSMM99] taken alone and/or in view of the teachings of Okutomi and/or in view of the teachings of Lewis do not teach, anticipate, or suggest, the presently claimed "...determining 3-D depth of the plurality of pixels in the base image by matching correspondence to a plurality of pixels in three or more images, each image representing one of the at least three views of the scene, wherein the three or more images are captured simultaneously, and wherein each of the at least three views of the scene are situated in a non-linear arrangement and are further oriented in a plurality of non-parallel planes relative to each other; and tracing pixels in a virtual piecewise continuous depth surface by spatial propagation starting from the detected pixels in the base image by using the matching and corresponding plurality of pixels in the three or more images to create the virtual piecewise continuous depth surface viewed from the base image, each successfully traced pixel being associated with a depth in the scene viewed from the base image" as recited for amended Claims 1 from which Claims 10-11 respectively depend from, Applicant believes that the rejection of Claims 10-11 under 35 U.S.C. 103(a) has been overcome. The Examiner should withdraw the rejection of these claims.

Allowable/Allowed Subject Matter

Applicant would like to thank the Examiner for indicating the allowability of claim 29.

Conclusion

The foregoing is submitted as full and complete response to the Official Action mailed November 8, 2005, and it is submitted that Claims 1-29 are in condition for allowance or are at least presented in better form for appeal. Reconsideration of the rejection is requested. Allowance of Claims 1-29 is earnestly solicited.

No amendment made was related to the statutory requirements of patentability unless expressly stated herein. No amendment made was for the purpose of narrowing the scope of any claim, unless Applicant has argued herein that such amendment was made to distinguish over a particular reference or combination of references.

Applicant acknowledges the continuing duty of candor and good faith to disclose information known to be material to the examination of this application. In accordance with 37 CFR § 1.56, all such information is dutifully made of record. The foreseeable equivalents of any territory surrendered by amendment are limited to the territory taught by the information of record. No other territory afforded by the doctrine of equivalents is knowingly surrendered and everything else is unforeseeable at the time of this amendment by the Applicant and the attorneys.

The present application, after entry of this amendment, comprises twenty-nine (29) claims, including four (4) independent claims. Applicant has previously paid for twenty-nine (29) claims including four (4) independent claims. Applicant, therefore, believes that a fee for claims amendment is currently not due.

If the Examiner believes that there are any informalities that can be corrected by Examiner's amendment, or that in any way it would help expedite the prosecution of the

patent application, a telephone call to the undersigned at (561) 989-9811 is respectfully solicited.

The Commissioner is hereby authorized to charge any fees that may be required or credit any overpayment to Deposit Account **50-1556**.

In view of the preceding discussion, it is submitted that the claims are in condition for allowance. Reconsideration and re-examination is requested.

Respectfully submitted,

Date: 2/8/2006

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